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Mathematics MPC2

(Specification 6360)

Pure Core 2

Report on the Examination

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General

In line with the demands of the June 2011 examination, this summer's paper provided a discriminating test of the students' mathematical ability and knowledge. It was slightly disappointing to find a substantial minority of students unable to make use of assistance given in structured questions, often because they did not recognise the mathematical significance of the information given; an enthusiasm to use processes without due consideration could lead to unnecessary and erroneous work.

Students appeared to tackle all that they could do without there being any apparent evidence of shortage of time. It is pleasing to be able to report that students this series answered questions in the required spaces, with supplementary paper being used by students where this proved necessary, rather than space for other questions, as instructed by the rubric on the front of the paper – this practice should continue to be encouraged by those preparing students for the examination.

Question 1

This question, which tested the use of standard formulae for arithmetic series, proved to be a welcome opener with a very large majority of students scoring full marks. As ever, those students who stated the relevant general formula before substituting the values put themselves at an advantage if they then went on to make a numerical slip. There were a few cases of students finding the sum to 100 terms in part (c), but this was only penalised by one mark. Most other losses of mark were due to arithmetical errors.

Question 2

This question, which tested the basic trigonometry section of the specification, gave the value of $\sin\theta$, enabling the area of the triangle in part (a) to be evaluated simply and exactly. This was misinterpreted as a value of the angle θ by some students, for which generous allowance was made in this and the final part. Part (b) specifically asked for the exact value of $\cos\theta$, the significance of which was ignored by many. Those who used the identity $\cos^2\theta = 1 - \sin^2\theta$ generally obtained the correct value and full credit was also given for a correct exact value straight from the calculator. The cosine formula was generally well-known and correctly written down in part (c), but there was a substantial minority of students who used the wrong order of evaluation, which resulted in $AC^2 = 30.25\cos\theta$. A higher proportion of students than usual seemed to have their calculators set in the wrong mode. The final mark was reserved for those calculating the length of AC without unnecessary approximation.

Question 3

This question, which tested positive rational exponents and integration, was another good source of marks for many students, although for a large minority finding the square of $x^{\frac{3}{2}}$ proved to be more of a challenge than was hoped, with $x^{\frac{9}{4}}$ appearing far too often from otherwise promising students. The indefinite integration and evaluation of a corresponding definite integral were tackled with much more success, with many correct solutions seen.

Question 4

Most students used the given formula for the nth term of the geometric series correctly, although a few assumed, incorrectly, that the first term was 48, for which some follow through allowance was made. The common ratio and sum to infinity were usually found correctly, although some students gave a value for the common ratio that was greater than 1 without ever realising that such a value was not appropriate for use in the sum to infinity formula as stated in the formulae booklet. The notation in part (d) was, as expected, found more challenging. However, the stronger students coped well, with a pleasing number using as their method the sum from the 4th term to infinity. A common error in part (d) was to assume that the value for the sum could be found by calculating $(S_\infty - S_4)$ rather than $(S_\infty - S_3)$, although the former was awarded some partial credit if correctly calculated.

Question 5

Finding the arc length and expressing the angle PTQ in radians in terms of π were generally done correctly in this question on radian measure and geometry. Most students then found the correct value for the area of the sector, but then using this proved challenging for the average grade student. A further length was needed, which was usually correctly found by more able students. Finding the area of two triangles (or the kite directly), followed by the shaded area, required connected use of information given and found; this proved to be discriminating. Those who joined the points O and T and used basic trigonometry to find the length of PT $(=TQ)$ were generally more successful in finding the area of the kite than those who started by joining P to Q. There were a number of excellent solutions seen, mainly from students who supported their method by explicitly referring to unknown lengths from the given diagram.

Question 6

In part (a)(i) of this calculus question, where students were asked to verify that a given expression was equal to zero when $x = 2$, a minority of students failed to give adequate written evidence, particular when the order of calculation was important; the minimum examiners accepted here was $3\times 4-\frac{4}{4}-11=0$, although $12-1-11=0$ was more convincing. In part (a)(ii) the differentiation of $-\frac{4}{x^2}$ was a hurdle not always overcome by the weaker students. However, those who first re-wrote it as $-4x^{-2}$ usually went on to differentiate it correctly. Many students scored the mark for giving a correct reason in part (a)(iii). In part (b) a large number of the students did realise that they needed to integrate the given expression for the gradient to find the equation of the curve but a significant number of them did not include the arbitrary constant which is essential here, and only a minority knew how to find its value from the given information. Although only a minority, it was still disappointing to see more students than expected writing down the equation of the curve in the form $y - y_1 = m(x - x_1)$.

Question 7

This question on trigonometric equations and identities was by far the least-well-answered question on the paper. The equation was given in a factorised form (in the hope that students would be led to write down $\tan\theta + 1 = 0$, $\sin^2\theta = 3\cos^2\theta$) but this was overlooked by many students who chose to multiply out, and create a more complicated problem from which recovery was unusual. Even those who separated the two factors, and divided the second by $\cos^2\theta$, often 'cancelled' $\dfrac{\sin^2\theta}{\cos^2\theta}$ erroneously to $\tan\theta$. Of those who overcame the initial hurdles, a substantial number ignored the possibility of a negative square root and so missed the value $-\sqrt{3}$ for $\tan\theta$. However, those who found a numerical value for $\tan\theta$ in part (a) were generally able to find the corresponding solution in the given range.

Question 8

The sketch of the given exponential curve was generally well-done although some students did not display sufficient care in sketching the curve in the negative-x region. In part (b), the majority of students were awarded the mark for correctly eliminating one of the variables, but a significant number could not form a quadratic with any confidence. Those who recognised that 7^{2x} could be written as $(7^x)^2$ usually had no difficulty in proceeding to form and solve a correct quadratic equation in y and then to find the correct value for the y-coordinate of the point of intersection, although a small minority of these students did not give sufficient consideration to the rejection of the inappropriate negative solution. The usual errors seen are illustrated by the following: $7^x = 7^{2x} - 12 \Rightarrow 12 = 7^{2x} - 7^x \Rightarrow 12 = 7^x$ or $7^x = 7^{2x} - 12$ $\Rightarrow \log 7^x = \log 7^{2x} - \log 12$. There were, however, an encouraging number of completely correct solutions.

Question 9

The application of the trapezium rule in part (a), followed by the request for the vector of a translation in part (b), provided a good opportunity for most students to make a good start to this final question. Using log laws in the correct order on $\log(10x^2)$ defeated the average and below average students, even with the answer given. It was quite common to see $\log(10x^2)$ initially written as $2\log(10x)$ and then, with less than convincing logic, the incorrect expression became the right-hand side of the printed result. Identifying and describing the stretch was, as expected, discriminating. Only a small minority identified $\mathrm{f}(ax)$ as $\mathrm{f}(\sqrt{10}\,x)$ here, although many more gained some partial credit. Having this part (c)(ii), following the given result in part (c)(i), was a deliberate connection often ignored by students. Again, in answering part (c)(iii) students could make good use of the printed result, and this was frequently taken up by better students who generally made good progress for the first two or three marks. However, in general, only the most able students could give the correct gradient of OP in the form requested.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results statistics page of the AQA Website. UMS conversion calculator www.aqa.org.uk/umsconversion